Behind The Forecasts

Terminology and Forecast Language

The NWS has a unique way of describing expected weather. Some of the terms used to describe time periods and weather conditions may seem arbitrary, but there are rather specific meanings attached to them.

Time Periods

Time Period	Definition
today	sunrise to sunset
tonight	sunset to sunrise
morning or in the morning	sunrise to noon
afternoon or in the afternoon	noon to around 6 pm
evening or in the evening	from 6 pm to midnight

In the Zone Forecast Product the first three days are divided into both day and night periods. A night period crosses over midnight as outlined above. Days four to seven are mentioned only as days, but are defined as calendar days from midnight to midnight. For example, in the short term (within three days) “Sunday night” means from sunset Sunday evening until sunrise Monday morning. Lows for Sunday night most of the time would technically occur early Monday morning before sunrise, but are mentioned in the Sunday night period. In the long term beyond three days, “Thursday” means exactly Thursday from midnight to midnight. Low temperatures in this case most often will refer to lows early Thursday morning before sunrise.

Sky Conditions

Sky conditions are described depending on how many tenths of the sky is covered by opaque clouds (clouds that completely block the sun).

clear or sunny	less than 1/10 opaque clouds
mostly clear or mostly sunny	1/10 to 2/10 opaque clouds
partly cloudy	3/10 to 6/10 opaque clouds
mostly cloudy	7/10 to 8/10 opaque clouds
cloudy	9/10 to 10/10 opaque clouds

High cirrus clouds are often somewhat transparent, so even if the sky is full of them the term mostly clear or partly cloudy may be used. In contrast, a small patch of fog can entirely obscure the sky from an observer's point of view. It may be cloudy or foggy at that point, but only a mile or two horizontal distance away the skies are completely clear. That patch of fog is so low it is below the horizon from an outside observer's perspective. This is often the case with varying terrain, a shallow marine layer, and dense fog. Fog may persist at the beaches while only a few hundred feet inland it is clear. Forecasters attempt to include language to specify the range of possibilities, but cannot describe every possibility without becoming entirely too wordy. A mostly sunny forecast may be a bad forecast to the few people underneath a tiny isolated patch of fog, but a correct forecast to the other 99% of the population. By contrast, high clouds can be seen hundreds of horizontal miles away.

Winds

Wind direction is always given **from** which the wind is blowing (e.g., a northwest wind is a wind coming from the northwest). Wind speeds are given in miles per hour. Terms that may be used to describe wind speeds are defined in the following table.

0-5 mph	light or light and variable
5-15 mph	none used
15-25 mph	breezy (for mild weather) brisk or blustery (for cold weather)
20-30 mph	windy
30-40 mph	very windy
40 mph or greater	strong, damaging, dangerous

Since winds are highly variable in time and space, usually the strongest winds expected anywhere in the zone are mentioned. For people in areas normally protected from the wind, this understanding is important. "Local" is a term often used to imply that indicated winds will not blow over the entire area, but at some unspecified locations that may differ in time and space. Often, winds are influenced by terrain creating a predictable wind pattern. If there is enough confidence about exactly where and when the winds will take place, a better description is given. Phrases such as "mainly through and below passes and canyons in the morning" are often included to add beneficial detail.

Temperatures

Temperatures are often given in ranges such as "upper 60s to mid 70s", but for brevity simple numerals such as "42 to 50" are also used. Here is what we mean with some of the described temperature ranges:

Described as...	Means...
Near 40	38 to 42
around 85	a range from 83 to 87
lower 50s	temperatures of 50, 51, 52, 53, 54
mid or middle 70s	temperatures of 73, 74, 75, 76, 77
upper 30s	temperatures of 36, 37, 38, 39
60s	60 to 69

For example, “mid 50s to mid 60s” means 53 to 67. In numerous weather situations temperature ranges can be very large; a forecast of the entire range would not be useful, and a detailed description would be too wordy. Extreme temperature outliers are simply left out of the range and the forecast is made for the majority of the area. For example, on a clear morning in the San Bernardino Mountains outlier low temperatures may be 29 degrees in a high mountain valley and 51 degrees on a foothill slope. A forecast covering that entire range (“upper 20s to lower 50s”) is not very useful, so a judgement is made that most lows within that zone will be in the mid 30s to mid 40s. This is a more useful and brief forecast. Observers over time will come to know where their location fits with respect to the standard forecast ranges.

Precipitation

The idea to use probabilities for whether it was going to rain began with the National Weather Service in 1965. The original concept was to provide a risk-benefit assessment for people to whom the occurrence of rain was critical. For example, a contractor might decide to pour concrete if the chance of rain is only 30 percent, but he might decide not to pour if it's 60 percent. **Probability of Precipitation (PoP)** is the likelihood (expressed as a percent) of measurable liquid precipitation (or the water equivalent of frozen precipitation) during a specified period of time for any point in the forecast zone. **Measurable precipitation is defined as 0.01 inch or more.** PoPs accompany **expressions of uncertainty** or **areal qualifiers** within the forecast narrative. For example, a slight chance of rain (20%) is an expression of uncertainty that means at least one location in a zone should receive measurable precipitation 2 out of 10 times (20%) given a similar weather situation. Or, to state the converse, rain is NOT expected 8 out of 10 times. The probability has nothing to do with the amount of rain, how long it will rain or the percentage of the area that will get rain. When showers are mentioned in a forecast, there is a high likelihood of them occurring somewhere in the area, and thus the probability refers to the amount of the area in the forecast that will get wet, and receive an areal qualifier. “Scattered showers” means that 30 to 50 percent of the zone’s area gets hit by at least one shower and receives measurable precipitation. Below is a table of these two descriptive methods and their relationship to PoPs.

PoP Percent	Expression of Uncertainty	Equivalent Area Qualifiers
10-20 percent	slight chance	isolated
30-40-50 percent	chance	scattered
60-70 percent	likely	numerous (or none used)
80-90-100 percent	(none used)	(none used)

Other qualifying terms may be used with the above non-numerical expressions.
Terms of duration: brief, occasional, intermittent, frequent
Terms of intensity: Very Light: less than 0.01 inch per hour
Light: 0.01 to 0.10 inch per hour
Moderate: 0.10 to 0.30 inch per hour
Heavy: greater than 0.30 inch per hour
For trace events (precipitation of less than 0.01 inch), the terms "drizzle," "light rain" or "sprinkles" will be used, often with a PoP of 10%. Our marine environment can bring dense fog (which can be very misty), heavy condensation, and drizzle. Most of the time these marine layer precipitation events result in a trace, even when road surfaces become completely wet. For more on the philosophy of probabilities, check out the Uncertainty section under Forecast Challenges below.

Forecast Tools

Today's forecaster has a large variety of tools available. Many advances in technology and the understanding of meteorological principles in recent decades have added a great deal to the science. Seven day forecasts today are more accurate than three day forecasts were 20 years ago. Meteorologists blend their own knowledge and experience with the data provided by these tools to make a forecast.

Satellite

Satellite data is one of the more essential forecasting tools. The satellite in use over the western U.S. is the GOES - West Satellite. This satellite is geostationary, meaning that it rotates along with the earth so that it is always over the same place on the earth. Three basic images are generated from this satellite: visible, infrared and water vapor imagery. Polar-orbiting satellite data are also used. These satellites orbit the earth crossing the poles. Several additional specialized images are also available.

Visible imagery is like a camera snapshot from space, recording reflected visible light from the earth's surface. All clouds are white. The image goes black as the sun sets. Since all clouds are white, it is sometimes difficult to tell at what levels these clouds exist. **Infrared** images are actually measurements of temperature, rather than reflected light as in visible satellite images. Warmer objects appear darker than colder objects. Cloud temperatures are related to cloud height, and relative cloud height can be readily inferred. **Water vapor** images are useful for pointing out regions of moist and dry air. Dark colors such as black and dark grey indicate dry air while bright colors such as white or light grey indicate moist air. Swirling wind patterns in low pressure systems and jet streams are easily identified. Other derived satellite products have been developed, such as the **fog** product. In San Diego this is commonly used at night to easily detect very low clouds and fog common to our region. For more background on satellite imagery, click on: **www.srh.weather.gov/jetstream/remote/satellite.htm**.

Radar

Doppler Weather Radars were installed during the early 1990s and marked the beginning of a new era in detecting and forecasting weather. The official name is **NEXRAD WSR-88D**, meaning NEXt Generation Weather Service RADar-1988 Doppler. Technicians at the San Diego office maintain two Doppler radars: one east of Scripps Ranch in San Diego, and one in the Santa Ana Mountains near Corona. While some media outlets claim Doppler radars as their own, only the National Weather Service owns and maintains weather radars in our area. In addition to detecting areas of precipitation called **echoes**, the Doppler Radar also detects movement and intensity of the precipitation. The radar also detects wind velocity and direction, useful for detecting rapid shifts in wind direction, including tornadoes. These data alert forecasters to the possible need of warnings or advisories.

How does it work? The radar sends out a beam of energy that strikes an object. Some of that energy is reflected back to the radar. The velocity of the object can be derived from the phase change of the beam's wavelength as it returns to the radar. The radar has many limitations. Due to occasional atmospheric conditions, the beam is bent toward the ground and detects ground effects (hills, trees, structures) called "clutter." The beam scans the atmosphere in slices, one angle at a time. As the beam angles upward, the beam may be over 20,000 feet high at a distance beyond 100 miles. Significant weather can occur below the beam completely undetected. In addition to raindrops and ground effects, the radar can detect birds, insects, dust, etc. Military operations often include spreading **chaff** (tiny, fine metal strips) into the atmosphere. Chaff is a wonderful reflector for the radar beam and shows up on the radar display as an intense radar echo. Often, a quick look at the satellite image can help verify that this is not precipitation. Echo signatures of chaff look quite different in appearance than actual precipitation and can be easily identified by the trained eye, but it becomes more difficult when echoes of legitimate precipitation are also present. For more information about Doppler Radar, click on **www.wrh.noaa.gov/radar/radinfo/radinfo.html** and **www.srh.weather.gov/jetstream/remote/doppler.htm**.

Observations

Surface observations are current weather conditions measured at a point on the earth's surface. The most reliable and accurate source of hourly weather observations are automated surface observation systems, called **ASOS** stations, a network of standardized equipment funded and maintained by the NWS. This equipment, usually located at airports, transmits at least one hourly observation called a **METAR** (METeorological Aviation Routine weather report). METARs are written in METAR code, an international weather descriptive code.

A network of **ALERT** (Automated Local Evaluation in Real Time) equipment is used primarily for hydrological purposes, measuring rainfall and river levels, but also temperature and wind in some cases. This equipment is maintained by flood control agencies in cooperation with the NWS.

Another network of weather instrumentation is **RAWS** (Remote Automated Weather Station) data, used primarily for fire weather forecasting support. The network is maintained by several other federal and state agencies, such as the California Department of Forestry and the Bureau of Land Management.

A large variety of **other weather data** sources are available, mainly on the Internet. These include school networks, resorts, businesses and private citizens with weather equipment. We use these sources only as a last resort and with caution due to their occasional low levels of accuracy and reliability.

Upper Air Observations provide valuable data. Forecasters need to know the behavior of the atmosphere in three dimensions, not just at the earth's surface. Observations of the upper air are taken by weather balloons with an attached radiosonde, a small packet of weather instruments. Radiosondes transmit the observed weather conditions as the balloon rises. The data is collected by radio receivers on the ground and plotted as a vertical trace called a **sounding**, on a thermodynamic diagram called a "Skew-T." This snapshot of temperature, dew point and winds in the atmospheric column is a most valuable set of data. A forecaster can identify temperature inversions common to our region, levels of instability and moisture, changes in wind speed and direction, and infer many other atmospheric behaviors. These balloons are launched the world over at 00z and 12z universal "zulu" time. In this way the world is synchronized with an accurate 3-D picture of the weather conditions twice a day. These data are among the most important input to computerized numerical weather models. However, the sounding network is rather sparse and soundings are taken only twice a day. In California soundings are taken at Miramar MCAS, Vandenberg AFB, Oakland, and occasionally Edwards AFB.

Satellite Sounders are becoming more adept at correctly inferring temperatures and winds at all levels of the atmosphere from GOES Satellites. Some of these data are becoming more included as input into computer model guidance.

Wind Profilers are surface based instrument grids that detect winds and temperatures in the atmospheric column. Most of these are maintained by the military, universities or other research institutions.

ACARS (Aircraft Communication Addressing and Reporting System) data are vertical traces of weather data taken by commercial airliners during ascents out of and descents into major airports. The frequent observations are valuable because they often fill in the time and space gaps between weather balloon soundings.

Forecast Models - Numerical Model Guidance

Once meteorologists have an accurate picture of the current atmosphere, the process of forecasting can begin. Scientists through the ages have come to understand some of the movements of the atmosphere through the study of physics, fluid dynamics, and thermodynamics. Mathematical equations called equations of motion have been developed to describe the movement of air in the atmosphere. By modifying these equations, removing the less important components, and inserting the weather data into the equations, a solution can be given for a future time. For example, if we know the temperature for a certain place at midnight, we can enter that value into the equation to get the temperature for that place at noon. This can be done for many time steps (i.e. 24, 36, 48 hours) into the future. These equations of motion are non-linear, meaning they cannot be solved by hand in a timely fashion; the weather event would occur before we could produce a forecast for it! This is why powerful computers are essential. The computer can make iterations, a long sequence of approximations which increasingly get closer to the solution. After numerous iterations, a solution arrives. The process is repeated for every weather parameter and for every grid point on the map. It works like baking a cake:

Data is collected: upper air, satellite, radar, surface observations, etc.	*Ingredients are gathered.*
Data is input into mathematical equations of motion to be solved by powerful computers.	*Ingredients are mixed and put in the oven.*
The computer generates a numerical solution in future time steps.	*The cake is baked.*
The solutions are checked for quality and plotted graphically on maps.	*The warm cake is sliced and served.*

In its finished form, the numerical model data arrives at each forecast office a few hours after the “run time”: 00z, 06z, 12z, and 18z universal time (a few localized models are run more frequently, but do not extend very far into the future). The data is ingested by AWIPS equipment available to the forecaster to analyze and formulate a forecast. It comes in graphical format or statistically generated text format.

Some guidance is received from national or regional centers regarding rainfall amounts, flooding and flash flooding potential, severe thunderstorms, hurricanes, etc. For example, if a big storm is coming and we need to figure out how much rainfall we’ll get, the San Diego office will receive guidance from the Hydrometeorological Prediction Center (HPC) in Maryland and the River Forecast Center (RFC) in Sacramento. They will provide valuable input for deciding how much precipitation will fall and what flooding impacts may occur. The Storm Prediction Center (SPC) in Oklahoma provides guidance on the probability of severe thunderstorms. In the end, the final decision and forecast rests with the forecasters in our office.

Advanced Weather Information Processing System (AWIPS)

Installed in San Diego in April 2000, AWIPS provides one-stop shopping for weather data used by the forecaster. Numerical model guidance, satellite imagery, radar data, and analyses can be viewed graphically. AWIPS offers the capability of viewing the model guidance in a variety of ways to get a four-dimensional understanding of the atmosphere's behavior. NWS alphanumeric guidance, observations, and text products nationwide are available.

Interactive Forecast Preparation System (IFPS)

IFPS is the software forecasters use for preparing and issuing forecasts as of November 2002. With this new system, forecasters manipulate a high-resolution gridded database that represents the expected weather, rather than writing text. IFPS then generates a suite of text, graphical, and gridded forecasts from the database. The main improvement is the greater degree of temporal and spatial detail available in the forecasts, with additional weather elements, such as relative humidity and rainfall amounts.

Forecast Challenges

Regarding Southern California weather, some observers may joke, "What weather?" Our climate and our profession have often been the target of jokes (e.g., "why don't you get a real job?!", "if I were as wrong as often as you are, I'd be fired!" or "is this where they send the junior meteorologists?"). It is true that our climate does not suffer the extremes of temperature, wind, and precipitation that many other climates do. The challenge of predicting our weather lies in the uncertainties, subtleties, and relatively infrequent extremes, not often in the severity. However, an enormous population base unfamiliar with severe life-threatening weather is less prepared for it when it comes, and that presents a new risk. Simple drizzle or light rainfall can be a killer. Compare traffic accident reports in Southern California when it rains with those reports when it does not rain, then look at the same figures for Seattle. Additionally, expectations differ with professions. A surgeon is expected to be perfect or very near perfect all the time, but baseball players are considered great when they successfully get a hit with only one third of their attempts. Stock market analysts are much less accurate and far more ambiguous than are weather forecasters. The public's expectations of weather forecasters are either too high (believing they should always be correct) or too low (getting burned by a bad forecast or the incorrect interpretation of a good forecast and never again trusting forecasters).

Despite popular belief, forecasting the weather in our region is not as easy at it seems. There are a number of questions to answer and puzzles to solve each day. These puzzles may be as innocuous as determining when the coastal clouds will clear or what the high temperature will be, but most of the time there are more significant issues. These issues are included in the **forecast discussion**. Reasons, opinions, clarifications, and expressions of model performance and preference are included. Formerly, these discussions were meant only for coordination purposes within the NWS meteorology community and transmitted through equipment that required extreme brevity. For these reasons, many complex meteorological terms, abbreviations, contractions, and jargon were used. In recent years discussions have become much more public (and posted on the Internet) and have become much more readable for non-meteorologists. One who reads the discussions day after day will quickly gain an understanding of the particular challenges the forecasters are facing, even when the weather is benign. The latest discussion can be found on our web page at: **www.wrh.noaa.gov/sandiego/LAXAFDSAN**.

Uncertainty

"To the often-heard question, 'Why can't we make better weather forecasts?' I have been tempted to reply, 'Well, why should we be able to make any forecasts at all?' "
- Edward N. Lorenz, MIT researcher, in *The Essence of Chaos*.

Chaos Theory is very real in meteorology. The tiniest errors in the initial conditions become very large errors in the solution. If a computer model does not initialize well, it is like a golf club swinging through the ball at an angle only slightly off perfection. The result, as many golfers know, is a large error in where the ball ends up.
Some uncertainties in our forecasts arise because of the lack of essential information. With our current knowledge and technology, it is impossible to account for all the possible variables that impact the weather. Our data networks may not be dense enough to detect some significant local effect. The leading researchers in the field may not have discovered the meteorological theory behind an event and forecasters may not even understand everything that is actually taking place. The forecaster may not be fully aware of the situation or sufficiently experienced to detect something important. Sometimes the weather simply defies explanation, or at least an explanation we can come up with. For example, if we look at two identical weather patterns with the same dynamics, moisture, temperature profile, structure, etc., we often see different results, like rain with one system, but not the other. We often ask how and why. After the event we can speculate on why it rained or didn't rain, and even come up with an acceptable explanation, but that's after the fact. We keep that in our records and in our brains for future reference. If the event is rather significant, we may even collect the data surrounding the event, analyze and study it in depth, and write and publish a paper as a case study.

Our climate and global position add to the uncertainty in our forecasts. San Diego is located just far enough south to be on the southern edge of the normal winter storm track. We may be on the edge of the area of expected rain. Promising weather systems may not maintain strength as they approach us. The weather system may bring local showers where some spots measure rain while the rest of the area remains dry.


Models.wav

Comparisons of satellite data to model guidance can be done on AWIPS to determine the quality of the guidance. This is called model initialization. For example, if the model guidance at 00z does not match closely to the observed atmosphere (model data and observations are overlaid on a satellite image) at 00z, then the initialization was not good. The forecaster may conclude that since this particular model does not have a good handle on the weather pattern, there is no way it will have a good handle on it in future; the forecaster will then discount or ignore its solutions. The model guidance may give us different solutions with each new model run, or the models' solutions differ with each other. When the models seem to disagree from run to run and/or with each other, forecaster confidence lowers. At times with a particular feature such as a storm, the models are very tardy to come into agreement, perhaps less than one day before the storm. When the confidence is low, the forecaster relies more on experience than the guidance, and as a result the forecast may become less specific.

In contrast to our challenges, the Seattle forecaster has it relatively simple: A storm approaches, forecast rain. It is only a question of when and how much. Many local folks demand that we could be so certain: “Just tell us, is it going to rain or not?” The science of meteorology is young. Many discoveries in meteorology theory and improvements in numerical model guidance are taking place, but there are still numerous hidden variables or nuances that can go undetected and change the weather. Our efforts to correctly define atmospheric motion in real time are clumsy at best. The NWS prefers to avoid giving an irresponsible and possibly misleading forecast of certainty when no such certainty exists. This is why we use terms of probability. The following true example is illustrative. One day the NWS issued a forecast with a 40% chance of rain for the next day. When the next day arrived, a radio personality reported rain where he was and questioned on the air: “Does this mean that the chance of rain was really 100%?” No. If we were to flip a coin, we know the chance of it coming up heads is 50%. If it comes up heads, it does not mean the chance of coming up heads before the coin flip was 100%. The chance is again 50% before the next coin flip. Failure of the broadcast media to grasp the probability concept can unintentionally change the meaning of the forecast that much of the public receives. Broadcasters are often heard to report a chance of rain, or even a slight chance, as “rain in the forecast,” significantly altering the meaning. It is human nature to add certainty where there is little.

misunderstand.wav

Forecasts can be misinterpreted or trusted too much. “A chance of showers” would have been a good forecast if only some areas get measurable rain (in the radio personality example above, the shower he experienced may have been the only one in the area). “Mostly sunny” is a good forecast if most coastal areas are sunny, even if a few beaches experience fog all day. “Locally windy” is a good forecast if a few spots are windy, even if most areas are not. Conditions change in both time and space. “Partly cloudy” may mean mostly cloudy at times or mostly sunny at times during the day, but for brevity’s sake the forecaster chose to simplify the wording. With the common low clouds, it may be completely cloudy in some spots and completely sunny in other spots, then the reverse occurs, all within the same zone; for this, “partly cloudy” might be appropriate forecast wording as well. It should also be remembered that forecasts are refreshed often. A forecast is routinely issued every 12 hours. Often, the forecast is updated between those routine issuances. By the time the morning newspaper reaches your door, there may already be two or three updates made to the forecast you are reading.

Forecasts for future time periods become more and more uncertain with each future forecast day. In 2001 the NWS began issuing seven-day forecasts as part of the routine public forecasts, up from five days previously. On average, NWS forecasters accurately predict the next day’s weather 90% of the time. Today's four-day forecast is as accurate as the two-day forecast was in 1985. The accuracy deteriorates as the forecast goes further out; the day seven forecast is just over 50% accurate. Beyond seven days, let’s be frank, the forecast is a flip of the coin. Some extended models can indicate which way to lean. Actually, the climatological normals become the best forecast beyond one week. When someone calls requesting a forecast for an outdoor wedding two months away, we give them the climatological normal high, low, and chance of rainfall for the date.

Long Term Prediction is fraught with uncertainty, but significant advances have been made in understanding the global climate and today there are more data available for analysis. In recent decades the weather altering mechanism **El Niño** has been a catalyst for these advances (for more on El Niño, see "The Weather of Southwest California - A Climate Overview" below). The **Climate Prediction Center** is a national agency and world leader in climate studies and long term predictions. They produce monthly and seasonal outlooks for the entire country. The outlooks are not exactly forecasts, but graphical expectations of whether temperature and precipitation will be above normal, near normal, or below normal. Sophisticated climate models take into account all important effects on global weather such as sea surface temperatures, pressure patterns, upper level winds, and the greenhouse effect.

Scarce Data

West and south of California lies the vast, open Pacific Ocean. There are a few buoys and ship reports, but it is largely devoid of data. To the south and east is Mexico with very few reliable data sources. Because much of our weather comes from the west or south, it is difficult to know just what kind of weather is headed our way. By contrast, most of the country has the advantage of looking west and learning exactly what kind of weather is headed their way. An old axiom states that if you want to know what weather to expect in New York City tomorrow, just look at the weather in Chicago today. The lack of upstream observations hurt California in another way. Numerical model guidance depends on initial data to get a correct start on the forecast. With very few data points over the ocean, the model has only a vague idea of the weather conditions before they reach land. Accordingly, the model often has trouble ascertaining the strength, position and/or timing of approaching weather systems. Yet another problem arises. Several model domains (areas covered by the model) have a western boundary not far out to sea. So some models do not "see" a weather system very well before it enters the domain. Once it sees the system, it may struggle to correctly represent and define it before it reaches land.

Even in our highly populated area with numerous data points, there never seem to be enough data points when they are most needed. That is because many weather phenomena are highly localized and very brief. California tornadoes are a good example of this. It is nearly impossible to forecast a Southern California tornado before it touches down. The Doppler Radar scans a slice of the atmosphere every six minutes at each beam angle. A tornado can touch down, do its damage and lift back into the cloud in much less time than the six minutes between radar scans. Additionally, a tornado may be distant from the radar and occur below the beam, and go undetected. Doppler Radars were built and tested for the severe weather of the plain states and are more attuned to detecting those larger scale severe storms. Luckily, California tornadoes are usually not as severe or damaging as those in the Midwest. In an effort to better detect these localized weather phenomena, we have nearly 700 volunteer weather spotters across our region who help us fill in the gaps in data. We also appreciate it when the media pass along a significant report to us.

Microclimates

Microclimates are very small scale climate zones. Southern California's highly complex terrain and proximity to the ocean help create a variety of microclimates. The weather can be very different between canyons and mesas, beaches and inland areas, mountain valleys and mountain slopes, urban and rural areas, and a number of other variables. On a clear night, overnight low temperatures may be 15 degrees lower in a canyon compared to a neighboring mesa. On a sunny day, high temperatures may be 15 degrees lower at the beach compared to the reading only a few miles inland. Winds may be strong through certain corridors, while neighboring areas are nearly calm. A mountain area may receive significantly more precipitation from a storm than that received in the valley at its foot.

These microclimates present a problem in forecasting the kind of detail that many users want. The forecast zones help to categorize the different weather expected for different areas, but even within the zone it is difficult to describe all weather elements spatially and temporally in detail. The new IFPS (Interactive Forecast Preparation System) is a grid based interface which can offer this kind of detail. It is a robust change to the way the NWS makes forecasts. Now a user is able to get a very detailed forecast for their exact location and how the weather will change throughout the day.